Space Weather Technical Forecast

Issued on Friday, 23 September 2022 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts throughout. G1 Geomagnetic Storm intervals expected today, Chance of G2. Likely Active Electron Fluence following over UTC weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity remained at Low levels over the past 24 hours, with frequent C-class flares. The largest flare was a C7.8 observed from AR3105 at 22/1134UTC. There are currently five sunspot regions on the disc. The largest sunspot group continues to be AR3105 (Ekc/beta). Of the remaining groups they are small to moderate in size and complexity, and generally stable. However, AR3107 (Cai/beta) and AR3108 (Dai/beta) both had a slight increase in area or spot number.
A filament eruption occurred from near the northeastern limb around 22/0200UTC. This is thought to now be appearing heading behind and slightly above the Earth in the track of its orbit to no anticipated effect at Earth.
A faint partial halo CME began to appear on Lasco C2 imagery earlier in the day, around 22/0720 UTC. Possible front-side sources are few, but there was a very faint dimming associated with the rapid emergence of AR3109 centre-disc at 22/0130UTC. However, source attribution is far from certain. Currently this CME is not expected to be Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, initially declined from slightly elevated levels to background levels, but then through the evening gradually returned to slightly elevated levels around 440 km/s. The solar wind density was predominantly at average levels, although in the evening a temporary increase to reach above average levels occurred, peaking at 19 ppcc. The IMF was weak and stable until 22/2059 UTC when a jump to moderate levels occurred, peaking at 10nT. The north-south component was predominantly positive, but had occasional weak southward fluctuations, reaching -2 nT. The phi angle was initially negative (towards the Sun), but then fluctuated around the middle of the day, before settling to become mainly positive (away from the Sun) after 22/1707 UTC. The solar wind parameters indicate that a SSBC occurred around 22/1707 UTC.

The corresponding geomagnetic activity was Quiet (Kp 0-2) until the end of the day, then becoming Unsettled (Kp 3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, remained very close to Background levels.

High energy electron flux (greater than 2 MeV) was at Normal Background to Moderate levels, with peak value 867 pfu at 22/2145 UTC. The associated 24-hour fluence remained well below the Active (1e8 integrated pfu) threshold. Observed fluence at 23/0001UTC was 1.18e7 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate with further C-class flares Expected and with an ongoing Chance of M-class flares. The main flare risk remains from AR3105 and AR3107 in the southeastern disc.

Solar Wind / Geomagnetic Activity: After starting at slightly elevated levels the solar wind is expected to increase this morning with the arrival of a HSS from CH25/+, becoming elevated by tomorrow (24th). Then a temporary, and slight, decline in the speed is likely during day 3 (25th) perhaps decreasing to slightly elevated levels, before a further enhancement is possible during day 4 (26th) with the arrival of a HSS from CH26/-.
Today activity is expected to increase to Active to G1/Minor Storms (Kp 4-5), with a Chance for G2/Moderate Storm (Kp 6) intervals. Conditions should then provisionally ease Quiet to Active (Kp 2-4) for tomorrow, and Quiet to Unsettled (Kp 1-3) for day 3 (25th), before becoming Unsettled to Active again for day 4 (26th). However, later day 3 (25th) geomagnetic activity may increase Active to G1/Minor Storm due to a glancing blow from the 21st Sept CME, although confidence is low regarding this.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES16, is expected to persist at Background levels.
The high energy electron flux (greater than 2 MeV) is expected to be at Background to Moderate levels at first, before rising day three and day four (the UTC weekend days) in response to fast wind arrival from CH25/+.

The associated 24-hour fluence is expected to stay below the Active (1e8 integrated pfu) threshold through most the period, but possibly rising above by the end of day 4 (26th).

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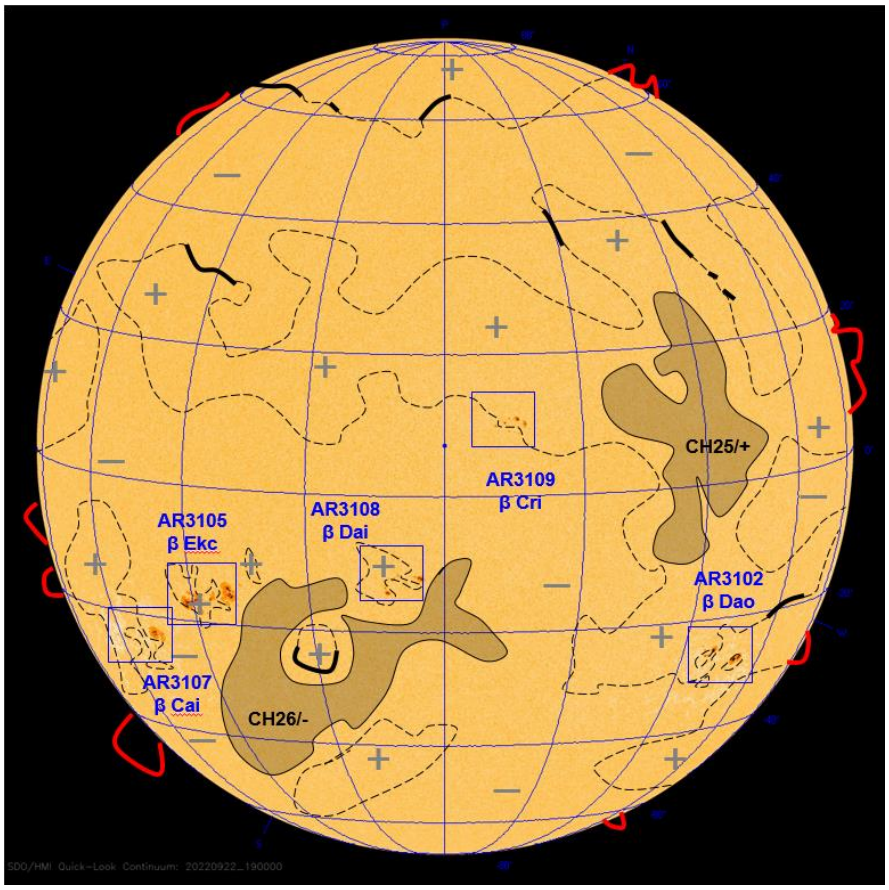
Figure 1. Solar Analysis Valid 22/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A slow CME seen leaving the southeast disc in C2 imagery on the 21st September has been assessed as having a possible Earth-directed component. MOSWOC Enlil suggests that a glancing blow is possible later in the UTC day of Sunday 25 September. However, confidence is low regarding this, and further analysis may be conducted should further triangulating imagery from STEREO A become available.
The solar wind is expected to become elevated today with the arrival of a HSS from CH25/+. On the current rotation this coronal hole feature is a much larger and more well-defined, compared to the previous rotation, and speeds of 500-600km/s speeds are expected. Today is the autumnal equinox, and by some theories this represents the annual peak in geoeffectivity for positive coronal hole features. Therefore, there is 40% chance of a G2/Moderate geomagnetic storm interval occurring today.
Tomorrow geomagnetic activity should then ease to become Quiet to Active (Kp 2-4), and Quiet to Unsettled (Kp 1-3) for day 3 (25th), before becoming Unsettled to Active again for day 4 (26th) as the HSS from CH26/- arrives. However, later day 3 (25th) geomagnetic activity may increase Active to G1/Minor Storm due to a glancing blow from the 21st Sept CME, although confidence is low regarding this.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	80	40	30	10
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
22/0532	Partial	AR3105?	SE quadrant	309 km/s	Late in UTC day on 25th	Source origin uncertain. Low confidence in forecast.

Figure 2: Met Office REFM ensemble forecast.

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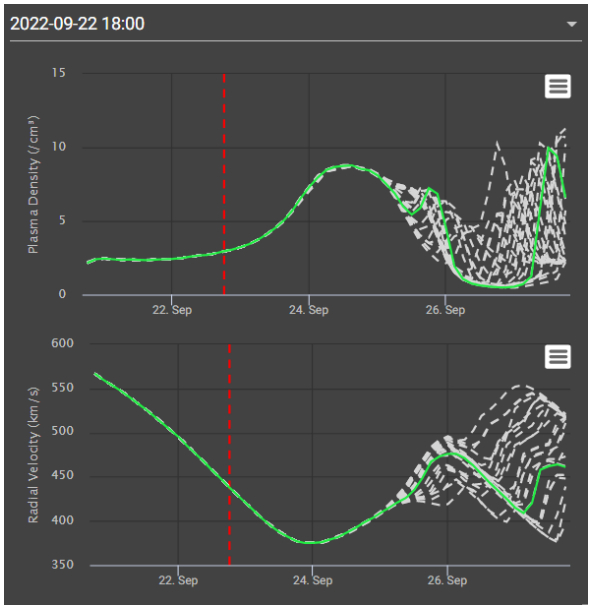
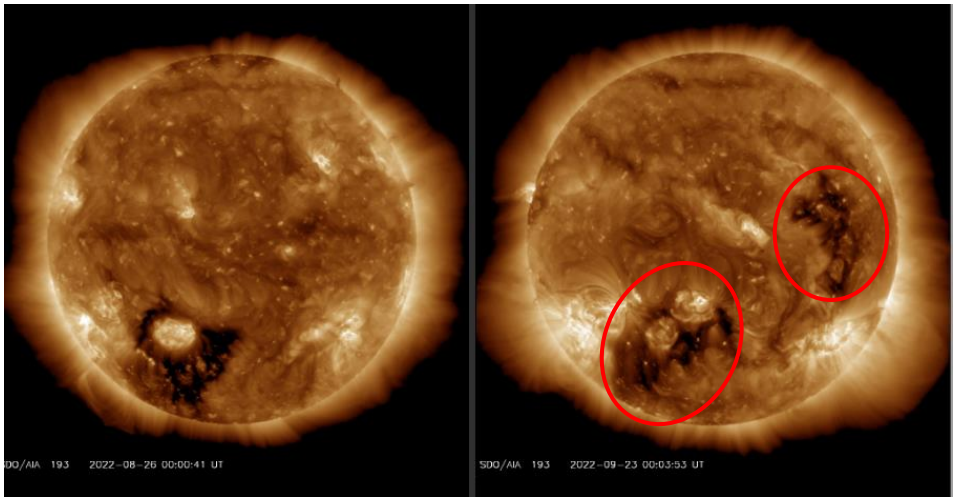


Figure 3: SDO AIA 193 images of previous rotation (left) and current rotation (right), with CH25 and CH26.



Radio Blackouts - X-Ray Flares:

There are currently five numbered sunspot regions on the visible disc: AR3102 has continued to decrease in area, length and spot number, and is now classified as a Dao/beta. AR3105 persists as the largest and most active spot, currently classified as Ekc/beta despite reducing slightly in area and spot number. AR3107 showed a slight increase in spot number, with trailing spots developing, and is close to becoming Beta-Gamma classification. AR3108 has developed intermediate spots, and is now classified as Dai/beta, although the penumbra on leading and trailing spots is rudimentary. AR3109's is unchanged as a Cri/beta.
Low to Moderate levels of activity are forecast to continue, with frequent C-flares Expected, and a Chance of M-flares. These are most likely from AR3105. Towards the end of the forecast period new regions are likely to rotate onto the visible disc, potentially increasing the solar activity.

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X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at or very close to Background levels, as the main flare risk sunspots currently populate the southeastern disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as observed by GOES16, is currently Background to Moderate. The arrival of the fast wind of CH25/+ today is expected to enhance electron populations at Earth, with High flux levels perhaps developing during days 3 and 4 (25th and 26th) once initial geomagnetic activity subsides - if the 21st Sept CME does not arrive during day 3 and maintain enhanced geomagnetic activity and so suppressing the high energy electron count.

The associated 24-hour fluence is expected to stay below the Active (1e8 integrated pfu) threshold through most the period, but possibly rising above by the end of day 4 (26th). The REFM is giving a good guide, keeping the fluence below the Active threshold during the first 3 days. However, as the HSS from CH25 is likely to be stronger than persistence suggests, so the REFM will struggle to show this. Therefore an increasing trend in the fluence is preferred.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)

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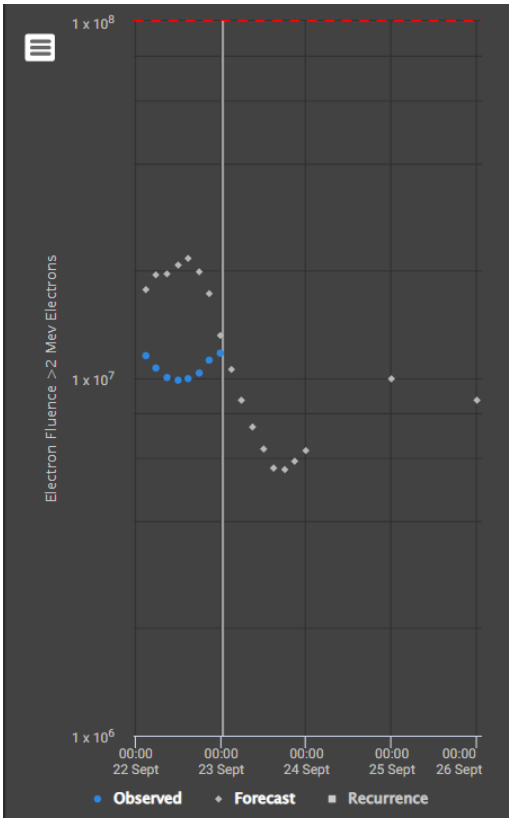
Active	**≥ 2 MeV ≥ 1x10^8**	No	1	20	40	60
Very Active	**≥ 2 MeV ≥ 1x10^9**	No	1	1	1	1

Figure 4: Met Office REFM model.



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